Biennial Review 1989-91

ENVIRONMENTAL CENTRE

The Alberta Environmental Centre is the province's major facility for applied environmental research, technology development and services. Officially opened in 1981, its 28,000 square metres of research facilities are located on a 300-hectare site in Vegreville, 100 km east of Edmonton. Funded through Alberta Environment, the Centre services all provincial departments and agencies which identify environmental problems requiring study. Specific projects are undertaken after review by a Technical Advisory Committee, and approved by a Board of Directors. The Centre's five Divisions — Plant Sciences, Chemistry, Animal Sciences, Environmental Technology and Common Services — accommodate over 300 staff carrying out studies to provide new knowledge for the solution of environmental problems.

Alberta
ENVIRONMENT

ALBERTA ENVIRONMENTAL CENTRE
BIENNIAL REVIEW
1989-91

Alberta Environmental Centre
Vegreville, Alberta

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Table of Contents

Introduction 5

Analytical, Diagnostic, Extension and Technical Services 8

Environmental Toxicology 12

Pest Management Research and Development 14

Living Natural Resources 16

Land Resources Research Management and Development 17

Waste Management Research and Development 19

Water/Wastewater Research and Development 20

Technical Support 21

Administrative Support 24

Alberta Environmental Centre Programs/Projects 25

Staff Roster 30

Publications 34

Staff Committee Memberships 42

1989-91 Expenditures 43

Organization Chart 44

Introduction

The Alberta Environmental Centre, a major provincial scientific facility, provides research and analytical services as backup to the Alberta government in its role of protecting the environment in this province. Work at the Centre, whether research, service or technology development, is carried out at the request of "clients" — government departments and agencies, and through them for industry and the people of Alberta. The clients identify the environmental problem; Centre staff then use a variety of techniques, in laboratory and field work, to find practical and cost-effective solutions.

Although for organizational purposes the Centre is divided into five Divisions - Chemistry, Animal Sciences, Plant Sciences, Environmental Technology, and Common Services - technical programs and their projects are organized into nine program areas. The purposes and accomplishments of our programs for the 1989-91 period are described in this review. Highlights for each of the program areas are summarized in this introduction to serve as examples of Centre activities.

Environmental Isotope Laboratory's Benezene Synthesizer

Analytical, Diagnostic, Extension and Technical Services

- Wide range of capabilities to test for environmental contaminants, such as pesticides, inorganic substances, trace organic compounds, and microorganisms.
- Immediate response to emergency situations requiring analyses.
- State-of-the-art analytical and bioassay services to back up regulatory and enforcement agencies concerned with air and water quality.
- Identification of and control recommendations for problem weeds, insects, plant diseases, chemical damage to vegetation, and problem wildlife.
- Western Canada's only radioisotopes facility provides consulting and research services.
- Publication of analytical procedures manuals.
- Methods development of metals analysis in biota and river sediments.
- Special project to study air quality in and around Drayton Valley.
- New methods developed for the analysis of organic compounds in precipitation samples.
- Methods Manual for Analysis of Trace Organics in Environmental Samples completed.
- Developed a rapid and sensitive method for selenium analysis in animal tissues.

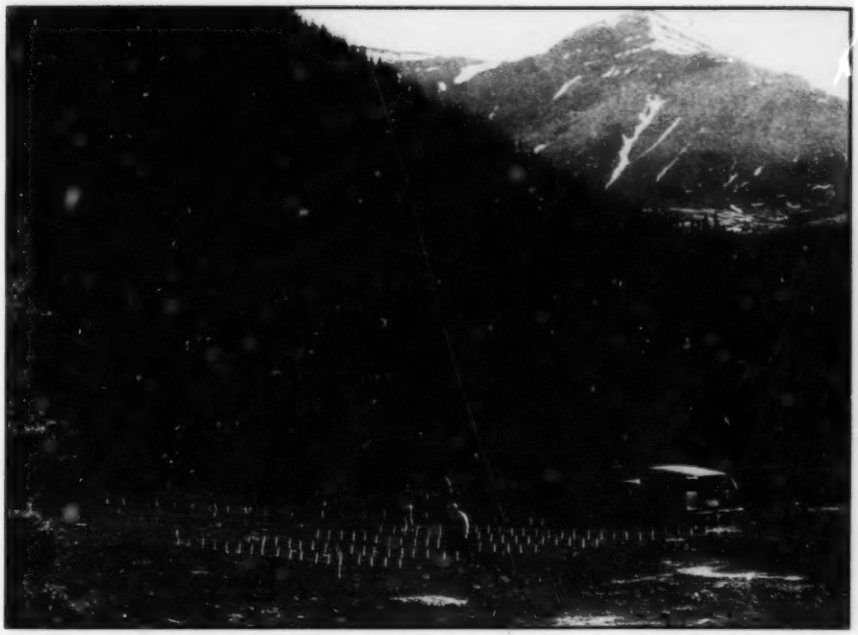
Environmental Toxicology

- Inhalation toxicology facility to study the toxic effects of hydrogen sulphide (principal contaminant of sour gas) and other gases.
- Grass carp reared at the Centre and released for weed control in irrigation canals, reducing use of chemicals.
- Non-invasive technique developed to assess the eye irritation caused by hydrogen sulphide, the main toxic component of sour gas.
- Several intensive investigations conducted into possible livestock poisoning from environmental pollutants.

Pest Management Research and Development

- Research into economical and environmentally safe control of

problem weeds, insects, plant diseases, and wildlife.
- Expertise in biological control of weeds and greenhouse insects to reduce reliance on chemicals.
- Research on how to manage herbicide residues in a crop rotation and on how to avoid residues in the soil.
- A parasitic wasp used in study on non-chemical control of the sweet potato whitefly, a recently introduced pest of greenhouse crops.
- A root-feeding flea beetle successfully established on leafy spurge in southern Alberta and redistributed from there to numerous sites throughout the province.
- Natural diseases of weeds isolated and tested for their potential as mycoherbicides (microorganisms used as non-chemical control agents).



Native grass evaluation on an abandoned coal mine

Living Natural Resources

- Five-year study on fish in Gleniffer Lake (Dickson Dam reservoir) completed.

Land Resources Management Research and Development

- Reclamation studies of soils compacted by heavy machinery.
- Long-range project to minimize upward movement of salts into topsoils by using certain crops in a rotation.
- Selection of native plant species for the reclamation of disturbed lands - industrial and recreational.
- A micropenetrometer and a soil consolidometer developed as tools in soil reclamation work.
- Soil compaction, a major hindrance to plant and tree establishment on logged areas and well drilling sites, being studied to find ways and means of minimizing its effect.
- Native grass and legume species being selected and tested to determine the best lines for eventual registration as preferred revegetation species in land reclamation projects.

Waste Management Research and Development

- Dioxin and furan analytical procedures added to the Centre's capabilities.
- Cooperative studies with New Jersey Institute of Technology and the United States Environmental Protection Agency completed; the feasibility of containing organic contaminants using treated clays was demonstrated.
- Decolourization of Kraft bleach pulp effluent by white rot fungi demonstrated.
- Capability of white rot fungi to degrade PCBs demonstrated.

Water/Wastewater Research and Development

- The Centre's two mobile water treatment plants used in solving drinking water problems.
- Major study completed on acute toxicity of wastewater treatment plants to two fish species and two invertebrate species ; no toxicity to test species when ammonia removed from the wastewaters.
- Acid deposition research program established.
- Centre staff dealt with a fish virus disease at the Cold Lake Fish Hatchery. Research was done in cooperation with the University of Alberta.

- With Alberta Agriculture initiated project to test commercially available small- scale ozone water treatment systems.

Technical Support

- Specialized services in support of research are: library, pathology, growth chambers and greenhouses, computers and instrumentation, photography and graphics, biometrics, site and vehicle services.
- Animal Care and Use Committee reviewed 32 animal research proposals and 25 standard operating procedures.
- Greenhouse and growth chamber facilities significantly increased the range of projects that can be undertaken at the Centre.
- A unique control and alarm system developed for the Centre's recycle and water treatment plant involving a voice recognition unit and automatic dial in/out capability.
- Data management being facilitated by the Local Area Network (LAN) and DEVELNET systems. Laboratory Information Management System (LIMS) being upgraded.
- Centre organized and was main presenter of the first All-Alberta Applied Statistics and Biometrics Workshop held October 1990 in Edmonton.

Upgraded laboratory information management system

- Centre assisted a local soil conservation society with equipment acquisition and field day organization.

Administrative Support

- The Centre's clerical staff helped produce scientific papers, bulletins, procedures manuals and books; and also organized symposia, workshops and international meetings.
- A high awareness of safety resulted in an excellent Centre-wide safety record.
- Centre staff were the main organizers of the first Toxic Round-Up in the Town of Vegreville.
- Enthusiastic support for Environment Week's Adopt-a-Classroom program.
- Projects supported by external funds continue to increase.
- Solution found to alleviate the space problem in the library.
- Research journal review resulted in a number of titles being eliminated.

Analytical, Diagnostic, Extension and Technical Services

During 1989-91, Centre staff continued to provide high-quality analytical and diagnostic environmental services to internal and external clients including the public and other Alberta Government departments. Quality Assurance/Quality Control programs ensure that the data quality meets client requirements.

Analytical services were routinely provided to ongoing programs at the Centre. In response to demands for emergency analytical services, the Centre provided identification and quantification of accidental spills, industrial discharges and public health emergencies. Legal samples from chemical spills, industrial discharges exceeding licence limits, and deliberate dumping of toxic/hazardous waste materials were tested immediately, regardless of the hour or the day.

Water Analytical Services

The Water Analysis Laboratory continued to process the largest volume of analytical services provided by the Centre. During 1989-91, a total of 23,510 samples were received. A total of 340,611 chemical determinations were completed (1) for the evaluation of drinking water for human consumption from private households and municipal water treatment plants, (2) for the examination of industrial effluents for compliance monitoring, (3) for the assessment of rivers and lakes water quality, and (4) to provide analytical services for research projects at the Centre. The Water Analysis Laboratory participated in five major research projects at the Centre during 1989-91.

Method development of metals analyses in biota and river sediments was completed for the Environmental Assessment Division. Samples of plant and animal tissues and of river sediments were analyzed for a variety of heavy metals for the Battle River Multi-Media Project. In collaboration with the Alberta Research Council, methods proposed for the analyses of drilling muds and gas plant sludges were evaluated through round-robin sample exchanges with other institutions and private sector analytical laboratories.

Research and method development on the quantitation of hydrogen sulphide (H2S) in various aqueous and nonaqueous matrices continued during 1989-91. One scientific paper was published. The results of the method development for H2S in biosamples were presented at the International Conference on Hydrogen Sulphide Toxicity at Banff, Alberta. A paper on the liberation of non-acid labile sulphide from brain tissue of H2S - poisoned animals was published.

Air Analytical Services

Ambient air and source emission samples collected province-wide by Alberta Environment Department's Environmental Assessment and Pollution Control Divisions were analyzed at the Centre. The sampling network includes fixed monitoring stations in urban and industrial areas. Air samples were also collected and analyzed for complaint and investigation purposes. Approximately 12,600 samples were analyzed during 1989-91.

A special project was undertaken in 1990-91 to study the air quality in and around Drayton Valley because citizens of the town were concerned. Methods were developed at the Centre to monitor for odorous compounds in the vicinity of pulp mills and oil sands extraction plants. By providing a state-of-the-art analytical service the Centre plays a key role as backup to the regulatory services which ensure that the province's air quality continues to meet high standards and that all industries in the province comply with their licence requirements.

Precipitation Analytical Services

The Centre also provides analytical services to Alberta Environment's acid deposition monitoring program, and it participates in the Long Range Transportation of Airborne Pollutants (LRTAP) program. Staff carried out analyses of precipitation samples and performed related monitoring and equipment calibration as a service to other groups. New methods were developed for the analysis of organic compounds in precipitation samples.

As directed by the Minister, the Centre established a greenhouse gas monitoring capability. Under that project, a suitable method for measuring atmospheric greenhouse gases such as methane and carbon dioxide is being developed.

Soil Analytical Services

The emphasis of these services on the measurement and interpretation of physical properties in relation to soil degradation, plant performance and rehabilitation has meant that staff had to develop new equipment and procedures to stay abreast. A micropenetrometer and soil consolidometer, described in the Soil Reclamation Research Program, are used continuously in analytical services. In addition, a root washer and image analyzer,

developed in earlier years, allow for critical measurements of plant performance in response to changing soil conditions. Specialized equipment is complemented, of course, by the standard procedures and instrumentation of a soil physics laboratory: pressure plates, particle size analysis, wet and dry sieving, Proctor (compaction) tests, thermocouples and neutron moisture and density gauges.

The demand for specialized services related to hydrocarbon contamination of soils continued to grow. Previous work resulted in the development of an extremely precise method for extracting total oil and grease from soil. A simple method for measuring water repellency was developed and promoted as a useful field technique for land reclamation specialists. Instrumentation is now available for measuring hydrocarbon fractions to isolate the specific contributing factors of water repellency.

Trace Organic Analysis

Polychlorinated biphenyls (PCBs) are chemicals of high public concern, however only trace amounts are found in Alberta and they are not expected to cause any adverse human health effects.

The Centre's analytical capability extends to thousands of organic chemicals. A total of 3,350 samples were analyzed in 1989-91. The major clients of this service are Alberta Environment's Environmental Protection Services and the Public Health Units. Projects included investigations of 120 hydrocarbon and PCB spills, screening of 90 industrial effluents to ensure licence compliance, and identification of organics in five Alberta river basins.

Water drop on water repellent hydrocarbon contaminated soil

In response to public concerns about chlorinated organic compounds in effluents from bleached kraft mills, the Centre developed and implemented methodology to measure "adsorbable organic halides" (AOX), to help regulate mill discharges under the Clean Water Act. Methods were also developed to measure chlorinated phenols, resins and fatty acids in industrial effluents and their receiving waters. For the northern rivers surveys conducted during 1989-91 by the Environmental Assessment Division, 537 samples were analysed for 16,160 parameters.

A comprehensive method development program culminated in the compilation of the "Methods Manual for Chemical Analysis of Trace Organics and Pesticides in Environmental Samples". This manual describes all of the methods currently being used for the various analyses for trace organic chemicals.

Microbiology

The Centre's microbiological analytical services used by many external and internal clients are: identification (through computer-assisted microbial systems that identify microorganisms to the species level), toxicity testing (identification and evaluation of the toxicity of chemicals, industrial effluents, leachates, and spills), and quantification of microbial populations in waters, soils and wastewaters. During 1989-91, 860 diverse environmental samples were analyzed for 16,133 microbial parameters. Major clients included various Branches of the Centre, Alberta Environment's Environmental Protection Services and Alberta Agriculture. Follow-up consultations were also provided to clients, particularly for data interpretation.

Research on microbiological processes in waste management continued in 1989-91. This involved experimental work on chromium removal from industrial wastes using

bioreactors, performance assessment of on-site domestic wastewater treatment technology, and the detection and quantification of odorous compounds of microbial origin associated with piggery waste. A total of 1,120 samples were tested for 8,690 microbial and biochemical parameters as part of these research and developmental studies.

Writing and editing work began on a Microbiological Methods Manual scheduled for publication in 1992.

Electron Microscopy

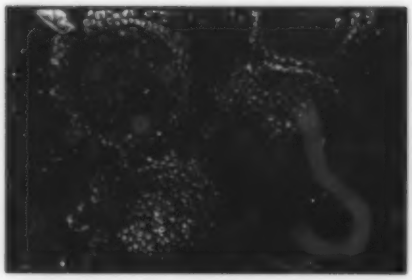
The Centre's electron microscopy facility provides analyses in support of research to clients within and outside the Centre. During 1989-91, 1,971 submissions were processed which included: (1) the identification of bacteria from wastewater and sludges, (2) determination of possible pollutants from air filters collected from air monitoring sites around the province, (3) impact of inhaled particulates on the structure of mammalian lungs, (4) microscopical structure of heavy metal interaction in the phases of different cement matrices, (5) identification of microbial pathogens in predatory mites used as biocontrol agents of greenhouse crops, (6) ultrastructural study of western gall rust fungus and (7) the effect and identification of pathogenic fungi on commercially important plants.

Environmental Isotopes

The isotopes program provides government agencies consulting, applied research, and service expertise based on the analyses for naturally occurring carbon and hydrogen radioisotopes to solve environmental and general earth sciences problems. It also provides radiation safety services, including radon analysis, for the Centre and Alberta Environment in all matters related to Atomic Energy Control Board requirements. As this is the only such facility in western Canada, a percentage of its analytical capability is also available on a fee for service basis to the private sector.

In 1989-91, research support was provided to seven government agencies in 30 project areas. In addition, externally funded projects provided $85,000 in analytical work and consulting in cooperation with the Alberta Research Council (ARC). A significant component of this work concerned environmental clean-up activities, monitoring and characterization of sites for waste disposal potential. Work for Alberta Agriculture and ARC centered mainly on hydrology-related studies, including soil salinity and aquifer characterization studies. The Geological Survey of Alberta at ARC requested studies related to preglacial gravels. Work with Forestry, Lands and Wildlife centered on peatlands forestry research while work for Alberta Environment and Alberta Culture was mainly for the Oldman River Dam project. Joint efforts with Alberta Culture's Archaeological Survey and the Provincial Museum were also required under government regulations in a number of archaeological site projects across the province. Environmental isotope work was also done for Alberta Recreation and Parks with the University of Alberta participation on erosion control at Dinosaur Provincial Park at Brooks.

Radiation safety expertise provided to Alberta Agriculture's phosphogypsum program dealt with concerns about radioisotope levels in the phosphogypsum stock piles and field application areas. Consolidation of all Departmental radiation safety duties into one Departmental Safety Officer at the Centre was accomplished in late 1990-91.



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Pest Management

The Centre continued its function as regional laboratory for pest diagnostic services in north-central and northeastern Alberta. Pest management specialists provided identification and control advisory services for insect pests, plant diseases and weeds. During the 1989-91 period, pest diagnostic submissions handled were 758 insects, 1,290 plant diseases and 521 weeds.

The Centre also has responsibility for chemical damage diagnosis for the entire province. During this period 614 submissions, comprised of 1,440 plant, soil and water specimens, were processed for suspected chemical damage to crops and other vegetation. Such damage occurs to sensitive plants mainly from herbicide spray drift and residue carryover in the soil. Centre staff do not assign blame for chemical damage nor assess damages. They provide diagnosis only and may act as expert witnesses if claims go to court.

Centre staff gave talks to farmers, other agricultural producers

and the general public at regional meetings, agricultural fairs and field days. Staff participated in the deliberations of national and international pest management advisory and scientific meetings, and in in-service training courses for agricultural field staff.

Pesticide Analysis

Pesticide analysis and methods development were provided as in-house services (for studies on pesticide application and chemical damage diagnostics) and as services for external clients such as Alberta Environment and Alberta Agriculture. More than 1,200 samples were analyzed in 1989-91 to provide support to various projects.

The Centre participated in Alberta Environment's province-wide evaluation of pesticide container collection sites. Samples were analyzed on behalf of Environmental Protection Services in support of their compliance and monitoring projects across Alberta.

Identification and quantification are part of the analytical service. Centre staff operated on a stand-by basis to analyze pesticide samples immediately in case of an environmental emergency.

Technical Services - Animal Sciences

During 1989-91, technical services provided to clients were: (1) 215 aquatic toxicity bioassays in support of regulatory activities under the Clean Water Act and the (federal) Fisheries Act, (2) live capture and release of trumpeter swans and woodland caribou in support of wildlife research, (3) risk analysis projects on contaminated groundwater, landfilling of industrial wastes and incinerator flyash, (4) field studies on cattle exposed to oil and gas industry activities, products and wastes, (5) algae population determinations and efforts to remove them from water at the Cold Lake Fish Hatchery, (6) providing advice on how to deal with a problem of toxic blue-green algal blooms, and (7) providing technology transfer assistance to private laboratories and post-secondary educational institutions.

Sample preparation for organic analysis

Work continued on the development of specific biochemical indicators for an early diagnosis of chemically induced injuries in rainbow trout and cattle. The Analytical Toxicology Laboratory developed a rapid and sensitive method for selenium analysis in animal tissues. Consultations were provided to Albertans on all aspects of environmental health and toxicology, and to scientists and health professionals nationally and abroad. Topics ranged from the quality of human foods, animal feeds, and drinking water to the potential impact of sanitary landfills on environmental health.

Under this program, the Centre co-hosted and assisted with organizing the North American Wildlife and Natural Resources Conference held March 1991 in Edmonton.

Quality Assurance/Quality Control

All laboratories at the Centre devote a great deal of time and resources to quality assurance and quality control (QA/QC) procedures. Quality assurance is an integral part of laboratory operations and quality control procedures are essential to ensuring that the results generated are valid and can be relied upon by clients. For example, the Water Analysis Laboratory participated in a comprehensive selection of round-robin studies with other provincial health and environmental laboratories, federal central and regional laboratories, as well as with municipal, university, commercial and industrial analytical laboratories. Participation in internal and external QA/QC studies and programs during 1989-91 involved about 53,500 chemical determinations over and above the analytical work done for clients by the Water Analysis Laboratory alone.

Environmental Toxicology

When natural or man-made substances enter our environment, whether planned or by accident, it's important to know what their effects will be. Scientists in the environmental toxicology program study the toxicity of many chemical and biological substances to ensure a safe environment in Alberta.

Inhalation Toxicology

The impact of gases, vapours, particulates and aerosols on occupational health and livestock is an important environmental concern. The Centre is one of only three laboratories in Canada with the capability for investigating the effects of exposure to airborne toxic chemicals for extended durations or at very high concentrations. The program was developed in response to public concern for environmental and occupational health issues. The major focus of the program to date has been the toxicity of single compounds, especially hydrogen sulphide (H2S), the main toxic contaminant of sour gas.

Research continued on the protective effects of Substance P, an endogenous neuro-transmitter, against pulmonary injury induced by H2S. It was found that depletion of this naturally occurring substance from the body greatly increased the toxicity of H2S gas. In addition, a non-invasive technique was developed to assess the eye irritation caused by this toxic gas. Work continued on the evaluation of data on effects of long-term exposure to it on lung function.

Studies on the biochemical mechanism of H2S toxicity in lung tissues were completed. The research provided a conclusive characterization of a very selective deleterious effect of gaseous H2S inhalation on cytochrome oxidase, a terminal and most important enzyme for cellular respiration, in lung mitochondria. This research was published in a scientific journal.

Microspheres in rat lung 700x

There is increasing concern for the effects of chemicals on the reproductive capabilities of workers. Techniques to evaluate the reproductive toxicity of chemicals in females and males were developed using animal models.

In preparation for a study of the potential adverse effects of airborne fungal spores, a technique to predict the distribution of particles of similar aerodynamic characteristics was established for the rat lung.

Planning began to change the focus of the program, from studies on the effects of a single compound, to investigation of the effects of exposure to complex mixtures, such as sour gas.

Toxicology of Biocides

Pour-on formulations of insecticides are used to control ectoparasites on livestock. Research completed at the Centre assessed the effects of selected organophosphate-containing pour-on insecticides on blood cholinesterases in cattle. The nature of these changes was also characterized. The results from these studies were published in scientific journals and presented at two international scientific conferences.

Research on development of biochemical and diagnostic biomarkers of toxicity is continuing. Scientific papers were published on the toxicity of methoxychlor to fish and on the effect of field spraying of insecticides on pheasants and partridge chicks.

In connection with research designed to reduce the use of aquatic herbicides, about 3,600 grass carp were cultured, verified to be

triploids (sterile) and released to the Irrigation Secretariat of Alberta Agriculture for controlled field trials in dugouts and irrigation canals in southern Alberta.

Toxicology of Petrochemicals and Fossil Fuels

Cattle often consume spilled crude oil. Studies were conducted to monitor subtle biochemical effects induced by the ingestion of an Alberta petroleum crude in cattle. The research characterized the cellular effects on the poison-metabolizing enzymes in liver, kidney and lung tissues. Research completed to date has been presented at three international toxicological conferences. New techniques were used to study behavioural pathological and biochemical aspects of voluntary ingestion of an Alberta petroleum crude by cattle under winter conditions. Because large quantities of methanol and diethylene glycol are used by the petrochemical industry, research was conducted on the acute toxic effects of these chemicals and their mixtures on cattle. Both chemicals were very toxic to cattle. They produced lesions in liver, eyes, kidneys and nerve tissues, and impairment of metabolic processes.

Several intensive investigations were conducted into possible livestock poisoning from environmental pollutants. In conjunction with evaluating toxicologic involvement in herd maladies, a thorough evaluation of livestock management, nutrition and trace mineral status, and infectious diseases was undertaken. Investigations into livestock poisonings involved hydrocarbon-contaminated ground and surface water, contamination from disposed drilling muds in buried sumps, waste disposal in a flare pit, sour gas emissions, and careless practices at petroleum service rigs resulting in animal poisoning. Various field observations and findings were reinforced by research results from the voluntary crude oil ingestion study and acute crude oil dosing in cattle.

Pest Management Research and Development

Research in developing environmentally safe and economical integrated methods of pest management is emphasised in this program area. Information on chemical, cultural and biological control methods was developed, and pesticide residues were detected and analyzed in environmental samples.

Insect Pests

Insect pest management studies were conducted to develop information on the protection of horticultural and field crops.

The greenhouse industry in Alberta has undergone expansion in recent years, and this has been accompanied by severe insect pest problems. The Centre supports research to develop integrated control strategies for greenhouse insect pests. A major objective is to investigate methods for implementing biological control measures as alternatives to chemical insecticides. For example, the sweet potato whitefly is a recently introduced pest of some greenhouse crops and research is being undertaken to determine the effectiveness of using a parasitic wasp to keep whitefly populations in check. In other biocontrol experiments the potential for using pirate bugs and predatory mites against greenhouse thrips is being investigated.

Several insect species can cause severe injury to field crops in Alberta, especially when their populations reach outbreak densities. Tradional methods of controlling insect pests through insecticide applications are not totally desirable because their residues can persist and they may kill beneficial insects. Consequently, research at the Centre on field crop insect pests is focused on developing cultural and biological control methods as alternatives or supplements to chemical applications. Research studies were began to evaluate tillage regime, seeding rate, and seeding date to reduce root maggot damage to canola. The effectiveness of a European parasitic wasp was evaluated for biological control of bertha armyworm. To assist producers in making decisions on whether or not to take control measures, research is underway to determine economic threshold levels for important insect pests of field crops.

Plant Diseases

The goal of the plant disease research is to maintain disease levels below the economic threshold. Field, laboratory and growth chamber experiments were conducted to develop effective methods for plant disease prevention and control in cereal, oilseed, forage and special crops.

Field surveys were conducted to detect recently introduced diseases such as blackleg of canola and to monitor their spread. Severity of established diseases, including crown and root rots of alfalfa and root rots of field pea, was also monitored.

Chemical control is an important component of integrated control strategies, therefore, research continued on performance evaluation of new and registered fungicides for controlling blackleg and seedling blight of canola, septoria leaf blotch and tan spot of wheat, scald and net blotch of barley and root rots of field pea.

Research efforts were also directed towards employing cultural and biological control measures in disease management. Studies were conducted on the evaluation of canola and pea cultivars for root disease resistance, on the effect of cutting frequency on snow mold development in alfalfa and on the role of beneficial microorganisms for control of root pathogens. Tests were conducted to integrate biological control agents and low rates of fungicides as seed treatments to control seedling blight of canola and root rot of field pea.

Root rot disease of field pea (healthy plants on the left) is a major problem in the production of this crop in Alberta

Weeds

Field experiments were conducted to investigate ecological approaches to weed management in canola and field peas. These included changes in crop seeding rates and row spacings to increase the competitiveness of the crops over the weeds, thus reducing crop yield losses due to weeds and weed seed production. This research will help in the development of integrated weed management systems with reduced dependence on herbicides.

Research on weed control strategies to avoid herbicide carry-over in soil included field studies on Treflan®, Edge® and Sencor®. Although these herbicides are effective, they can persist in the soil and affect the next year's crop. A related study investigated Tordon® residues in barley grain and straw following treatment with Tordon 202C®. Data from these studies

and others designed to investigate herbicide response and injury symptoms in crops and weeds were used to develop chemical damage diagnostic techniques.

Researchers investigated tolerance of new barley and wheat varieties to selected herbicides. This research is essential to help farmers using new cultivars avoid damaging their crops with registered herbicides. In growth chamber studies, chickweed and wild oat populations from several farms in Alberta were confirmed to be resistant to Glean® and Avadex BW®, respectively. Herbicide resistance, a relatively new phenomenon in Alberta, needs to be closely monitored since it has the potential to become a serious hindrance to crop production.

The Centre also carried out studies on biological control of weeds aimed at developing alternative methods to chemical control. In cooperation with the International Institute of Biological Control in Switzerland, Agriculture Canada's Research Station in Regina, and Alberta Agriculture, research was directed at screening and field testing insects in several problem weeds. A root-feeding flea beetle has been successfully established on leafy spurge in southern Alberta and was redistributed to numerous sites throughout the province. Other insects were tested and released on Canada thistle, toadflax and leafy spurge.

A survey of weed diseases in Alberta, funded by Farming for the Future, was completed. Several indigenous plant pathogens with potential as mycoherbicides were isolated and tested in the greenhouse for control of weeds such as Canada thistle, perennial sow-thistle, showy milkweed, dandelion and stinkweed. Four isolates were tested on their respective hosts in Centre field plots. In cooperation with Alberta Forestry, Lands and Wildlife one candidate mycoherbicide was applied to a natural stand of Canada thistle in the Blackfoot Grazing Reserve. This test will be repeated at least two more years.

Variety Trials

The Centre participated in a cooperative project with Alberta Agriculture to evaluate the performance of varieties of cereal and oilseed crops in northeastern Alberta. Field trials were conducted at Vegreville, St. Paul, Lac La Biche and Smoky Lake. This project allows Centre scientists to study genetic differences among test varieties in their susceptibility to diseases and insects before new varieties are licenced for commercial use.

A scientist making the first release in an experimental cage (June 1990) of the weevil Larinum planus for biological control of Canada thistle

Living Natural Resources

Understanding the biology and ecology of Alberta's fish and wildlife is key to the successful management of our living natural resources.

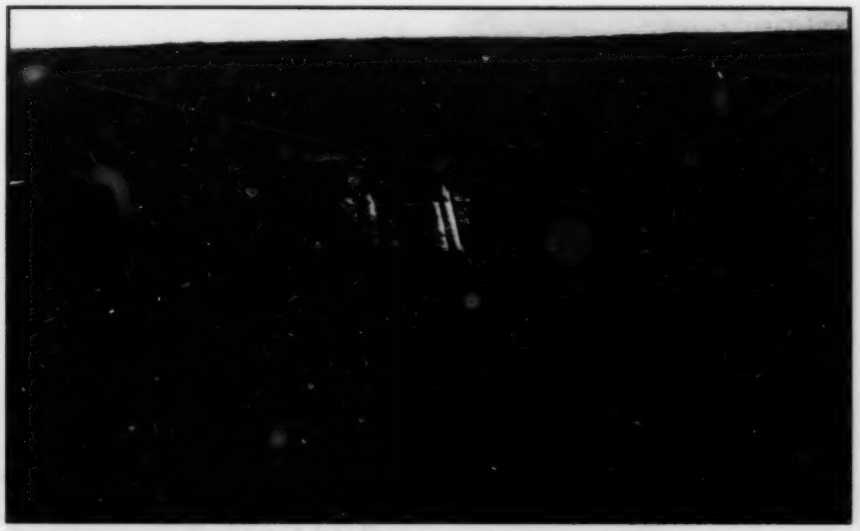
Ecological Studies

A five-year study on fish in Gleniffer Lake (Dickson Dam reservoir) was completed with the publishing of three Centre reports: the species composition and angler use of fish; a five-year study of mercury in fish; and the growth, feeding and fecundity of fish.

Planning was completed with Alberta Forestry, Lands and Wildlife and Public Works, Supply and Services for a five-year study of the abundance, growth and mercury content of fish in the Oldman Dam reservoir.

Humane Trapping

The humane trapping program was transferred to the Alberta Research Council in June 1989.



Dickson Dam (Gleniffer Lake)

Land Resources Management Research and Development

The land resources of Alberta, including soils and vegetation, are second only to the human resources in their importance and contribution to a high standard of living. These resources must be protected and maintained.

Government regulations stipulate that following all activities which disturb the land, such as oil well drilling and mining, the land must be returned to its former productivity. The Soils and Vegetation Branches at the Alberta Environmental Centre specialize in developing practical solutions that allow for the full restoration of productivity and sustainability on disturbed, degraded or contaminated lands.

Soil Reclamation

Research in soil reclamation in 1989-91 focused on three areas: soil degradation due to compaction, soil contamination by hydrocarbons, and the identification of soil and plant effects on salt movement and accumulation. Each of these areas was the subject of several experiments — some of short duration, others designed to last several years.

Research on soil compaction, its measurement, mitigation and prevention, was requested by Alberta Environment and the Alberta Forest Service. The Land Reclamation Division of Alberta Environment faces the dilemma of approving the reclamation status of heavily trafficked oil and gas drilling sites without knowing the consequences of soil degradation due to compaction. Similarly, the Alberta Forest Service must reclaim logging roads and landings (where trees are stockpiled for shipping) where compaction is so severe that all semblance of soil structure has been destroyed. Both organizations need a means of measuring compaction, a quantitative relationship between compaction and plant growth (for trees and crops), procedures for reclaiming heavily compacted soils and methods for preventing compaction on similar sites in the future.

Tillage of heavily compacted soil

The Soils Branch developed and calibrated the Centre Cone Penetrometer in 1988. It is widely used in Alberta to measure soil compaction in the field. In 1990, development of a "sliding sleeve micropenetrometer" for use in the laboratory to account for the effect of soil moisture and bulk density on soil strength was begun. A soil consolidometer and shear strength analyzer to study variations in soil strength with compaction was developed.

The response of plants to differences in soil compaction is being studied in a two-factor, field experiment using barley response to three degrees of compaction and four depths of topsoil. The results of the first two years show that subsoil compaction has a significant effect on yield and biomass production, but that most of the effect can be offset by deepening the topsoil from five to 50 centimetres.

A forest-based experiment on subsoil tillage of heavily compacted haul roads and landings showed that deep ripping is effective only if the subsoil is relatively dry (less than 0.1 MPa moisture tension). Otherwise, the soil between the ripper shanks is not affected and compaction levels remain high.

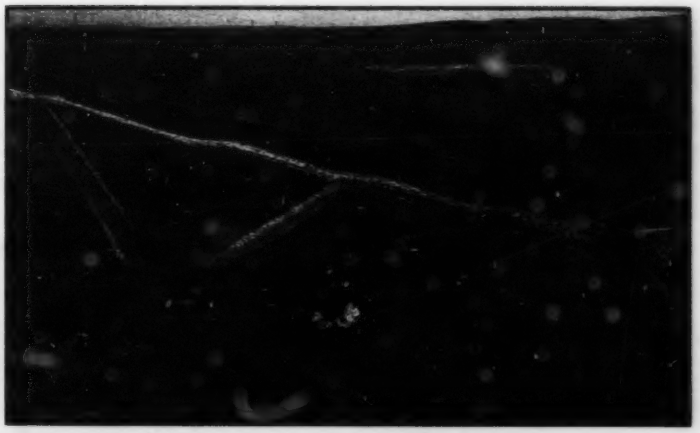
Field work continued on experiments designed to identify the effect of soil conditions and crop type on the movement and accumulation of salts. Of most interest is the comparison of perennial forage with annual crop on water use and salt movement. The alfalfa-bromegrass mix used considerably more water than either wheat, barley or canola and led to a substantial decrease in salt in the soil profile. Preliminary comparisons also showed that alfalfa-bromegrass mixes can prevent downslope movement of water (recharge).

Native Species for Reclamation

Disturbances of ecologically sensitive areas in Alberta result from mining, oil and gas development, pipeline and transportation corridor construction, tourism and other activities. Native plant species, particularly those adapted to disturbed environments, are well suited for reclamation use in ecologically sensitive zones. However, at present very little suitable plant material is commercially available for providing a self-sustaining cover on disturbed high-stress sites. The Alberta Environmental Centre has

a program to develop native plant material for use in land reclamation. The mission of this program is to undertake the research, development and testing of methodologies, operating procedures, practices and plant material required to successfully restore a native vegetation cover on disturbed, degraded or contaminated sites, especially in ecologically sensitive zones of Alberta. Work progressed on the development of a native grass-legume seed mixture for use in the east slopes of the Rockies, and the propagation and establishment of native forbs and grasses at the Oldman River Dam site for wildlife habitat mitigation and enhancement.

In the development of a native grass-legume mixture five native grass species, with potential for use in alpine reclamation, were chosen for the selection program: alpine bluegrass, slender wheatgrass, broadglumed wheatgrass, spike trisetum and sheep fescue. Plants of these species were collected from 330 sites along the front ranges of the Rocky Mountains and selections were made from these collections based on the performance of the progeny of each plant. In 1989, preliminary testing of the performance of selected slender and broadglumed wheatgrass and alpine bluegrass lines was completed at three locations (Vegreville, Columbia Icefields, and Sunshine Village). Data from these trials were used to select four lines of slender wheatgrass, three lines of broadglumed wheatgrass and eight lines of alpine bluegrass for testing in multilocation trials. Such trials were established in 1990 at Vegreville, Beaverlodge, Mountain Park and Columbia Icefields. These trials are the final stage of testing prior to the planned registration of the best lines in 1992. Sheep fescue and spike trisetum also showed promise for use on disturbed alpine sites. More work is required before lines of these species are ready for final testing.



Native grass reclamation on the face of the Oldman River Dam

The development of the legume component of the native grass-legume seed mixture was started with financial support of Alberta Environment's Reclamation Research Technical Advisory Committee and the Canadian Parks Service. In 1990, 13 legume species representing four common genera (Astragalus, Hedysarum, Lupinus, and Oxytropis) were collected from 34 sites in Waterton, Banff and Jasper National Parks, in Kananaskis Country and in the Cadomin, Cardinal River and Pincher Creek areas. Seeds were collected, cleaned, and seedlings were produced in the Centre's greenhouses to be transplanted into the field in spring 1991. Species will be evaluated and selected for seed production potential. The reclamation potential of selected species will then be field tested in conjunction with the native grass varieties being developed.

To reduce the environmental impacts of the Oldman River Dam construction and reservoir filling, Alberta Public Works, Supplies and Services implemented a comprehensive program of wildlife habitat mitigation. In 1989, monitoring and experimental projects were set up in cooperation with the Centre to evaluate the effectiveness of existing methods of protecting and enhancing plant communities, to evaluate methods and species selection in the creation of new wildlife habitat, and to provide input into planning supplemental and replacement plantings. In addition, Centre staff started to document the vascular plant species within the land base at the Oldman River Dam site and collected seeds of native forbs and grasses to be retained at the Native Plant Genetic Resources Laboratory at the Centre.

In 1989, the Centre initiated a cooperative project with Alberta Agriculture to manage the perennial forage variety trials in northeastern Alberta. This arrangement will allow Centre scientists to work closely with the agricultural community, to evaluate the agronomic performance of new forage varieties, and to compare the performance of these agronomic varieties to that of the native varieties being developed at the Centre.

WASTE MANAGEMENT RESEARCH AND DEVELOPMENT

The Centre continues to be involved in cooperative projects with other organizations. These included an international workshop on environmental pollution in Beijing, China, where Dr. Malcolm Wilson presented a paper and chaired a session on hazardous waste management; a federal-provincial evaluation of regulatory leaching tests; an industry-assisted project on PCB biodegradation; and an assessment of a process for pyrolysing municipal waste.

Incineration

Solid and liquid feeds, spiked with chlorinated organic compounds, were used in the pilot facility to ensure proper operation and to verify sampling and analytical methods. Modifications and refurbishment were undertaken to widen the operating range of the pilot equipment, and to overcome corrosion, condensation and adsorption problems in the sampling systems for the continuous monitors. Progress was made in sampling and analytical methods development for the measurement of trace organics in flue gases, including investigation of the effect of hydrochloric acid. Dioxin and furan analytical procedures were added to the laboratory's capabilities.

The quality assurance method used at the Alberta Special Waste Treatment Centre was further developed at the Alberta Environmental Centre so that it can now be used as a regulatory tool for proving that licence requirements are complied with.

Solidification/ Stabilization

Electron microscopic studies are continuing on mechanisms of leaching and containment of heavy metals. The experimental parts of the cooperative projects with the New Jersey Institute of Technology and the United States Environmental Protection Agency were completed. The feasibility of containing organic contaminants using treated clays was demonstrated. For certain solidified wastes, permeability was found to decrease over time due to liquid-solid interactions. This new phenomenon should be taken into account when conducting regulatory tests and when predicting leaching rates from results of laboratory measurements.

Biological Processes

Decolourization of kraft bleach plant effluent by white rot fungi was demonstrated. The accompanying changes in chlorinated organic compounds are still to be investigated.

The capability of white rot fungi to degrade PCBs was also demonstrated. The development into a site remediation process is being investigated.

Acid Deposition

An Acid Deposition Management Strategy for Alberta was proposed by a Task Group November 1, 1988 and approved by the Deputy Minister March 21, 1989. The Acid Deposition Program was added to the Alberta Environmental Centre's responsibilities in 1990-91 to ensure a coordinated approach to implementation of the management strategy recommendations for both the Acid Deposition Research and the Western and Northern Canada Long Range Transport of Air Pollutants (LRTAP) programs.

Micrograph of cement crystals 1500x

Program goals are to provide scientific and technical knowledge for limiting acid deposition, monitor wet and dry deposition of acidic substances, and establish reliable methods for prediction of acid deposition in Alberta.

Modelling studies which provided a first approximation of geographical distribution of acid substance deposition by season were completed. A workshop on the biological effects of acid deposition was held at the Alberta Research Council in December 1990.

A network of air chemistry observation stations equipped for wet and dry acid deposition monitoring using state-of-the-art sensing and data acquisition systems was initiated with a prototype station under construction at Royal Park, near Vegreville.

Water/Wastewater Management Research and Development

Research at the Centre is aimed at preserving and enhancing the quality of Alberta's environment through the development of sound management practices for water and wastewater.

Aquatic Toxicology

Work continued on development of acute and chronic bioassay procedures and the use of reference toxicants for quality control of bioassay results.

A major study completed on acute toxicity of influent and effluent from ten wastewater treatment plants to two fish species and two invertebrate species revealed no toxicity to the test species when ammonia was removed from the wastewater samples.

Research into the tolerance of fish to low dissolved oxygen concentrations at low water temperatures indicated that rainbow trout survive at extremely low dissolved oxygen levels in very cold water. Research is continuing to define the lethal dissolved oxygen concentrations for fathead minnow and lake whitefish at different water temperatures.

The regulatory arm of Alberta Environment requested expert technical advice on the effects of pulp mill development on receiving waters, as well as on drafting revised surface water dissolved oxygen standards.

Studies were initiated for technology development on the assay of liver enzymes, and blood electrolytes and gases of fish exposed to toxic agents.

Planning began on the organization of a workshop on QA/QC for private aquatic toxicity bioassay laboratories. This is required to standardize procedures used by the private sector in determining effluent toxicity as defined in regulations under the Clean Water Act. The workshop is supported by industry and partially funded by Western Economic Diversification.

Chemical Residues

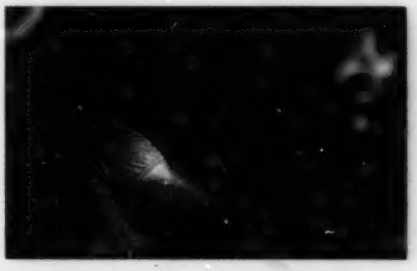
Papers were published on setting edibility standards for chemically contaminated fish in Alberta, and on the organochlorine residue levels in eggs and prey species of peregrine falcons.

Potable Water Technology

As part of the effort to model the Athabasca River, a study was undertaken to establish Ultimate Biochemical Oxidation Demand (UBOD) data for Alberta's pulp mills. This involved the evaluation of experimental methodology and the long-term (up to 350 days) analysis of 100 effluent samples at various temperatures. The data was used in the model to determine the oxygen profile of the river.

Because of the increasing concern over chlorate and chlorite discharges into Alberta's rivers and their impact on environment and human health, a project was undertaken to develop the analytical tools for the measurement of the levels of these constituents in pulp mill discharges and in river samples. A study was also began to evaluate the effectiveness of aerated lagoon systems currently in use for the removal of chlorate.

In a cooperative project with the City of Edmonton and the University of Alberta, researchers examined the influence of chlorine dioxide in the formation of aldehydes and other byproducts suspected of contributing to Edmonton's springtime water taste and odour problems. The Centre's demonstration-scale mobile water treatment plant was used for this work.



Ozone water treatment system evaluation

An outbreak of a fish virus disease, infectious pancreatic necrosis (IPN), at the Cold Lake Fish Hatchery required the installation of a raw water treatment system to prevent infection via lake water used in the hatchery. The disinfectant most amenable to this application is ozone. Consequently, it was necessary for the Centre to carry out a bench-scale study, in cooperation with the University of Alberta, to establish at which doses ozone was effective in killing the virus.

A cooperative project with Alberta Agriculture was initiated to evaluate the effectiveness of commercially available small-scale ozone water-treatment systems. This is part of an effort to examine and develop treatment alternatives for dug-outs and other rural water supplies.

The Centre assisted Alberta Environment in evaluating a proposed commercial technology for the clean-up of waste pesticide containers stored around the province. A short-term study provided information about the technology's effectiveness which allowed the Department and the company to better assess the proposal.

Technical Support

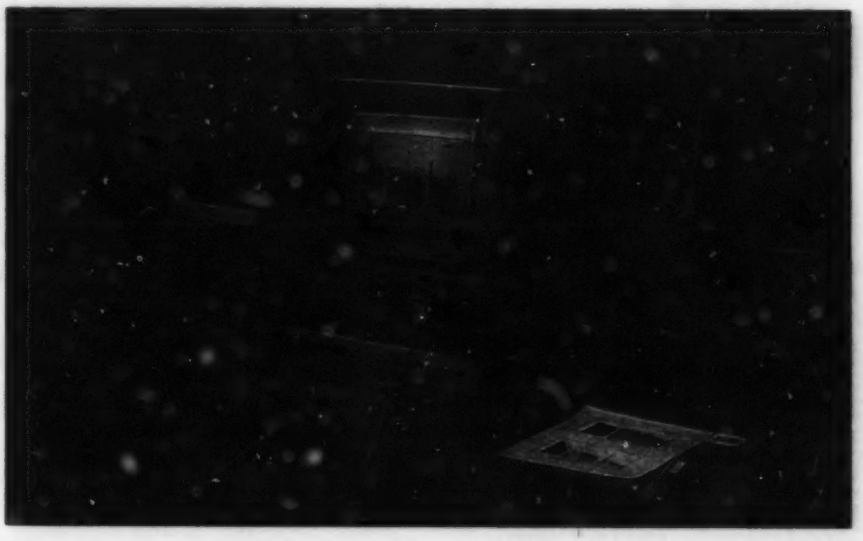
To efficiently operate a large establishment like the Centre, many of the internal services are centralized and offered to all Divisions to limit duplication of services and allow for the development of specialized personnel.

Animal Resources

The use of animals is essential in basic and applied research which increases our understanding of biological and ecological processes. An integral component of animal research is the proper care and treatment of experimental animals. The Centre's animal facilities house a diversity of animals — molluscs, fish, wildlife, laboratory rodents, and cattle. All animals are cared for under Standard Operating Procedures (SOPs) by staff with a wide range of expertise.

The Centre's animal facilities and procedures comply with the guidelines set forth by the Canadian Council on Animal Care. The Council's most recent inspection of the Centre's facilities and procedures resulted in an exemplary status given to the animal care and use program.

The Centre's Animal Care and Use Committee, comprised of animal and non-animal researchers, technical staff, and a community lay person, reviewed all research proposals and SOPs involving vertebrate animals. During 1989-91, the Animal Care and Use Committee reviewed 32 animal research protocols and 25 SOPs. In addition, it conducted inspections of animal facilities and has recently revised the Animal Care and Use Committee's terms of reference.



High quality computer graphics service available at the Centre

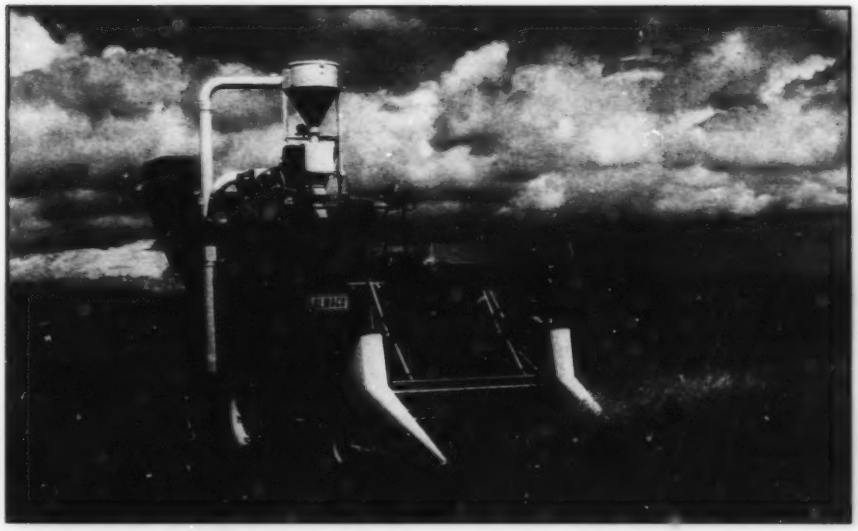
Pathology Services

The research support provided by this service to seven major research programs primarily involved preparation, examination and assessment of tissues from research animals exposed to various experimental toxicants. A necropsy, or post mortem examination was performed on each animal, samples were taken from all body organs (including blood), processed, and examined by a pathologist. Almost 1,000 necropsies were performed; approximately 11,500 tissues were examined by routine laboratory microscopy to detect evidence of changes (damage) associated with exposure to the environmental chemicals under study. More detailed examination of tissues was performed by use of the transmission and scanning electron microscopes. More than 3,300 tissue specimens were meticulously prepared at necropsy specifically for electron microscopic examination; of these, 333 were studied under the electron microscope to arrive at conclusions. Some 5,300 blood and serum samples were analyzed for evidence of changes in blood cells and blood chemistry profiles. More than 30,660 results (individual pieces of data) were contributed to ongoing research programs. In addition, 2,650 blood samples from grass carp were analyzed for red blood cell volume to assure that only genetically sterile carp would be released. These results were then confirmed by individual chromosome counts on over 300 selected samples. To ensure the validity of the experimental data, some 47,300 quality control procedures were performed.

Controlled Environments

This service maintains the physical facilities required to raise and propagate research plants. Thirty-six controlled environment growth chambers, four seed germinators and three greenhouses were operated at capacity during 1989-91, providing year-round growing condi-

tions for plant and pest studies. A preventive maintenance program was implemented for the growth chambers and greenhouses to ensure that high operational standards are maintained. Advice was provided to Centre staff on the horticultural aspects of plant research projects such as plant propagation, maintenance and pest management. The greenhouse and growth chamber facilities have significantly increased the range of projects that can be undertaken at the Centre. In many cases they also speed up research by allowing a crop to be grown in winter.



Harvesting native grasses with a specialized plot combine

Instrumentation and Engineering Services

This program continued to provide services to the Centre. Major activities included maintaining electronic and analytical equipment and the development of systems to monitor and control processes and experiments.

Staff helped researchers involved in the Incineration Program to integrate hardware expansions and modifications with the control system developed in-house.

A unique control and alarm system for the Recycle and Water Treatment Plant incorporating a voice recognition unit and a dial in/out capability was developed which permits the safe operation of the plant after regular business hours. This system was enhanced and connected to the Toxicology Laboratory computer to provide the same alarm annunciation capability to that facility.

Data Management Services

The Data Management Program developed a long-term strategy. It has been decided that NETWORK-related hardware and software must conform to appropriate international standards. Computer hardware and software training, consulting and programming services were provided to Centre staff.

A VAX-based Local Area Network (LAN) was acquired during 1990-91 and is servicing clients throughout the Centre. The DEVELNET system acquired during 1988-89 has been thoroughly integrated with Centre activity and as the LAN is being developed it will be integrated with the DEVELNET system through a gateway.

The PE/2000 LIMS (Laboratory Information Management System) underwent a disk upgrade in 1990 to avoid obsolescence. A LIMS replacement strategy was devised based on a LIMS model developed in-house.

Biometrics

Biometric Services were provided Centre-wide as an in-house resource in applied statistics, research methods and computer graphics. Research proposals were reviewed and/or statistically designed and analyzed. External clients included Alberta Agriculture, Agriculture Canada, and the Alberta Research Council.

In addition to research/statistical responsibilities, staff were involved with organizing and delivering five Centre-wide statistical applications and methods seminars and, with a grant from the Alberta Agricultural Research Institute (AARI), the first All-Alberta Applied Statistics and Biometrics Workshop (October 18-19, 1990). The latter event was attended by 60 persons from government, industry and universities in Alberta; proceedings were in final preparation by March 1991, and funds from AARI were granted for another workshop in 1992.

Photographic and Graphics Services

These services provided technical support by producing high-quality computer graphics, photographic

prints and slides for scientific conference presentations, poster displays, extension talks and other meetings, as well as photographic plates and figures for scientific journals and technical reports. In 1989-91, approximately 2,050 specimen photographs, 925 slides from printed text, graphics using computer software and computer slide image recorder, and 150 prints of graphics were produced. Assistance was provided to staff in the proper use of photographic equipment, and in production of graphics with computer software packages.

Site Support Services

Site services do not vary much from year to year in research support, site development, vehicle operations and maintenance.

Research support is the most complex of the three. In 1989-91 there were requests for land, equipment, supplies and technical services from soil and plant scientists, entomologists, microbiologists, aquatic biologists, animal scientists and engineers. Besides standard plot work, there were requests for equipment construction in the Site shop and novel animal care and handling procedures for deer and elk. Research support is given to projects operated by Centre scientists across the province — from Lloydminster to Jasper and from Ft. McMurray to the Crow's Nest Pass.

Site operations has grown because all of the land belonging to the Alberta Environmental Centre is now managed by Site. Previously, up to one-half of the 300 hectares was rented to farmers. The mixture of research has led to an increased demand for land and the redevelopment of spaces to permit specialized projects. Examples are the need for pasture and hay for cattle toxicology research and isolation strips for seed production from native grasses.

Sixty vehicles were scheduled and maintained for use by all staff. New monitoring procedures instituted in 1990 meant that more frequent and comprehensive vehicle checks had to be programmed.

Site Support Services took on a special project in 1990-91: soil conservation equipment advisory services. One staff member coordinated the distribution and use of several pieces of equipment purchased by a local soil conservation society. He contacted interested farmers, explained the purpose of the program and provided the equipment for their use. He also helped with a field day to familiarize them with the wide range of equipment, services and information available from the Soil Conservation Society.

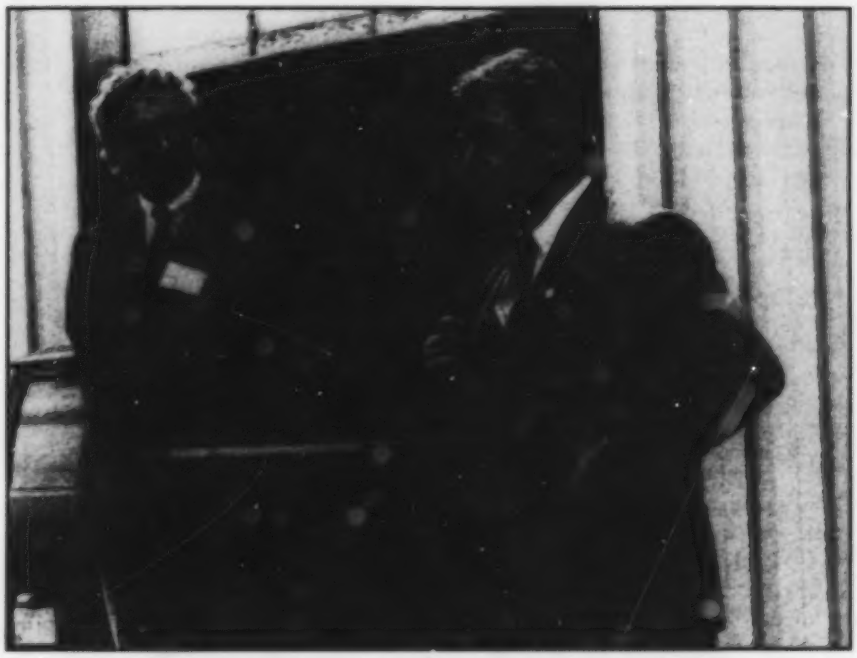
Administrative Support

The reductions in base budgets of the previous few years was halted in 1989/90. However, in spite of a slight increase in the base budget, there was a 3.0 man-years reduction in the manpower budget. In addition, external revenues of $232,290 were added to the Centre's budget during 1989/90 and $299,725 in 1991/92.

In 1989, staff from the Centre were instrumental in organizing a local coordinating committee who organized the first Toxic Round-Up in the Town of Vegreville. The local coordinating committee was honoured by the Minister of the Environment for having organized this event. It also participated in the 1990 Toxic Round-Up which had an increased response from the community. Centre staff also participated in other Environment Week activities, such as Adopt-a-Classroom and tours. One staff member was trained in public speaking so the Centre could participate in Alberta Environment's Speakers Bureau.

The majority of administrative and technical services that Centre staff require, such as refereed and Centre report preparation, workshop organization, progress reports, minutes of meetings, telephone reception, photocopying, inventory control, protocols, abstracts, posters, bibliographic listings, purchasing, warehousing, accounting, records management, library services, courier, and chemical waste disposal were provided.

Also, the administrative staff continued to provide payroll, occupational health and safety, nursing, recruitment, classification, and employee relations services to Centre staff. Notable accomplishments included the implementation of the Research Scientist Series and initiatives to improve performance management systems.



Environment Minister Ralph Klein officially opens Vegreville's first Hazardous Household Waste Round-up

The shortage of space in the Library reached crisis proportions as a result of the cancellation of all microform backset serials subscriptions. As 1990 and 1991 paper issues arrived and needed shelf space, a temporary relief was gained by sending some 2000 monographs to storage in early 1990.

However, progress towards resolving this crisis has been made during the last two years. The Library Committee reported on the benefits of a centralized, useable Library collection and on how one could be established for minimal cost, utilizing undeveloped laboratory space in the Plant Sciences Division adjacent to the Library. This recommendation was approved by the Executive Director and construction of the facility was completed in March 1991. Plans to weed and consolidate all Library materials in the Library Annex are well underway.

Alberta Environmental Centre Program/Project Lists (March 31, 1991)

PROGRAM	PROJECT	CLIENT AGENCY
Acid Deposition	Emissions	Environment
	Research	Energy
	Monitoring	
	Technology	
Administration and Research Support Services	Executive Management	Alberta Environmental Centre
	Administrative Services	
	Financial Services	
	Library Services	
	Central Records	
	Human Resource Services	
	Research Planning and Management	
	Biometrics Services	
	Staff Training and Development	
	Safety	
	Quality Assurance/Good Lab Practice	
	Capital Facilities Development	
	Lab Maintenance Engineering Services	
	Physical Facilities	
	Standard Operating Procedures	
	Photographic Services	
Analytical Services	Air and Water Analyses	Environment
		Alberta Environmental Centre
		Alberta Research Council
		Recreation and Parks
		Forestry, Lands and Wildlife
		Health
		Health Units
Animal Resources	Animal Care and Use Committee	Alberta Environmental Centre
	Animal Acquisition and Maintenance	
	- Laboratory	
	- Livestock	
	- Aquatic	
	- Wildlife	
Aquatic Toxicology	Toxicity Evaluation	Forestry, Lands and Wildlife
	- Industrial Wastewaters	Environment
	- Municipal Wastewaters	Alberta Environmental Centre

PROGRAM	PROJECT	CLIENT AGENCY
Biological Control of Weeds	Biology and Host-specificity Release and Monitoring Post-establishment Studies Biocontrol with Pathogens	Agriculture Forestry, Lands and Wildlife
Chemical Residues	Mercury Residues in Fish Chemical Residues - Colonial Nesting Birds - Peregrine Falcons	Forestry, Lands and Wildlife Environment
Chemical Safety Evaluation	Acute Toxicity Studies	Technology, Research and Telecommunications Agriculture; Environment Health
Controlled Environment Services	Growth Chambers and Greenhouses	Alberta Environmental Centre
Data Management Services	Research Computing Development Research Computing Operations EDP Telecommunications	Alberta Environmental Centre
Ecological Studies	Problem Wildlife Research Aquatic Habitat Studies Forestry Development and Wildlife Resources	Environment Forestry, Lands and Wildlife Agriculture
Electron Microscopy Services	Transmission Electron Microscopy Energy Dispersive X-Ray Analyses	Health Agriculture, Environment Health Units Alberta Environmental Centre
Environmental Isotopes	Development of Methods and Systems Radiation Safety Services C-14 and H-3 Environmental Research and Applications Stable Isotope Environmental Research and Applications	Agriculture; Environment Alberta Research Council Culture; Energy Recreation and Parks
Inhalation Toxicology	Biochemical Effects of Sulphur Gases Inhalation Toxicology Systems Development Acute Effects of Sulphur Gases Reproductive Effects of Sulphur Gases Hydrogen Sulphide Toxicosis in Domestic Livestock	Health Agriculture Environment

PROGRAM	PROJECT	CLIENT AGENCY
Insect Pest Management	Special Crops Insect Pest Management Field Crops Insect Pest Management	Agriculture Environment
Instrumentation and Engineering Services	Repair and Maintenance of Laboratory Instruments Engineering and Systems Design	Alberta Environmental Centre
Microbiological Services	Microbiological Enumeration Services Microbiological Identification Services Microbial Toxicity Service Microbiological Processes in Waste Management	Agriculture Environment Alberta Environmental Centre
Native Species for Reclamation	Native Species for Reclamation - East Slopes - Northern Alberta - Southern Alberta Selection of Salt-Tolerant Lines	Environment Public Works, Supply and Services Agriculture
Pathology Services	Necropsy Service Histopathology Service Clinical Pathology Service Ultrastructural Pathology Service	Alberta Environmental Centre
Pest Management Diagnostic and Extension Services	Insect Diagnostic and Extension Services Plant Disease Diagnostic and Extension Services Weed Diagnostic and Extension Services Chemical Damage Diagnostic and Extension Services	Agriculture Health Environment
Pesticide Analysis and Methods Development	Interdisciplinary Pesticide Research	Health Forestry, Lands and Wildlife Agriculture; Environment Alberta Environmental Centre
Plant Pathology	Disease Management - Cereal, Oilseed and Special Crops - Forage Crops	Agriculture

PROGRAM	PROJECT	CLIENT AGENCY
Potable Water Technology	Treatability of Surface Waters Subject to Effluents from Pulp Mills Giardia Cyst Removal and Inactivation Groundwater Treatment Colour, Taste and Odour Mobile Water Treatment Plant Ozone Technology	Public Works, Supply and Services Alberta Environmental Centre Environment Agriculture
Precipitation Studies	Long Range Transport of Air Pollutants	Environment
Site Support Services	Research Plots and Animal Facilities Vehicle and Equipment Maintenance	Alberta Environmental Centre
Soil Reclamation Research	Soil Analytical Services Water Use and Salt Transport Water Balance/Sodic Spoils Soil Compaction Biological Dewatering Inventions and Methods Legal Analytical Samples	Agriculture Environment Forestry, Lands and Wildlife Agriculture Canada
Technical Services (Animal Sciences)	Wildlife Biology Services Analytical Toxicology Toxicology Services Aquatic Biology Services	Agriculture Forestry, Lands and Wildlife Environment Alberta Environmental Centre
Technology Development in Waste Management	Incineration Solidification Fermentation Cellulosic Waste Utilization Research and Development Services	Agriculture Environment Technology, Research and Telecommunications Special Waste Management Corporation
Toxicology of Biocides	Toxicology of Methoxychlor to Fish Toxicology of Insecticides to Livestock Biological Control of Aquatic Weeds with Grass Carp	Agriculture Forestry, Lands and Wildlife Environment
Toxicology of Petrochemicals and Fossil Fuels	Toxicology of Petroleum Hydrocarbons to Fish Toxicity of Crude Petroleum to Livestock Toxicity of Petrochemicals	Agriculture Energy Environment Forestry, Lands and Wildlife

PROGRAM	PROJECT	CLIENT AGENCY
Trace Organic Analysis and Methods Development	Interdisciplinary Organic Containment Research	Health Forestry, Lands and Wildlife Environment; Health Units Alberta Environmental Centre
Weed Management Research	Weed-Crop Competition Weed Surveys and Population Dynamics Biology and Control of Aquatic Weeds Performance Evaluation of Herbicides Behaviour and Fate of Herbicides in Soil Chemical Damage Diagnostic Techniques	Agriculture Environment Recreation and Parks Forestry, Lands and Wildlife

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Staff Committee Memberships

Acid Deposition Program Management Committee

Air Quality Issues Committee

Alberta Agriculture Ecotoxicology Committee

Alberta Agrometeorology Advisory Committee

Alberta Aquatic Plant Management Committee

Alberta Biotechnology Committee

Alberta Cereal and Oilseed Advisory Committee

Alberta Climate Advisory Committee

Alberta Environment Executive Committee

Alberta Environmental Centre Board of Directors

Alberta Forage Advisory Committee

Alberta Government Libraries Council

Alberta Government Technology and Research Advisory Committee

Alberta Horticultural Advisory Committee

Alberta Interdepartmental Committee on Pesticides

Alberta Pest Control Advisory Committee

Alberta Vocational College
- Trapper Education Advisory Committee

Alberta Water Analysts Committee

Alberta Weed Advisory Committee

Athabasca River Basin Water Quality Planning Committee

Academy of Veterinary Disaster Medicine
- Board of Directors

Canadian Council of Resource and Environment Ministers (C.C.R.E.M.)
- Research Advisory Committee
- Working Groups on Drinking Water Technology Research; Incineration Research; Leachate Extraction Procedures; Pulp and Paper Research; Dioxins; and Air Toxics

Canadian Forum for Biological Control
- Steering Committee

Edmonton Mass Spectroscopy Users Group

Energy Resources Conservation Board

Entomological Society of Canada
- Governing Board
- Membership Committee

Canadian Petroleum Association
- Environmental Research Advisory Committee

Expert Committee on Weeds (Western Canada)

Humane Trapping Research Program Technical Advisory Committee

Institute for Research on Public Policy
- Board of Directors

Journal of Environmental Science and Health
- Editorial Board

Lakeland College
- Conservation and Reclamation Curriculum Advisory Committee
- Fish and Wildlife Curriculum Advisory Committee
- Regional Advisory Committee

Microscopical Society of Canada
- 2nd Vice President

National Radiocarbon Data Base Committee

NAIT Biological Sciences Technical Advisory Committee

North American Wildlife and Natural Resources Conference
- Planning Committee

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- Board of Directors

Phosphogypsum Applications Committee

Prairie Provinces Water Board
- Task Force on Water Quality Analytical Methodology

Prairie Registration Recommending Committee for Grain

Quaternary Geology Isotope Applications Committee

Reclamation Research Technical Advisory Committee

Western Canada Canola/Rapeseed Recommending Committee

Western Canada Microtox Users Committee

Western Committee on Crop Pests

Western Committee on Plant Disease

Western Expert Committee on Grain

Western Forum on Pest Management

Fiscal Year Expenditures

1989-90 (Thousands of Dollars)

	Manpower	Supplies and Services	Grants	Fixed Assets	Total
Common Services	728	625	0	8	1361
Plant Sciences	1620	348	0	132	2100
Chemistry	2157	280	0	251	2688
Animal Sciences	1686	350	0	135	2171
Environmental Technology	1234	652	0	299	2185
Acid Deposition and Alberta Environment Research Trust	0	417	348	0	765
Total	7425	2672	348	825	11270

1990-91 (Thousands of Dollars)

	Manpower	Supplies and Services	Grants	Fixed Assets	Total
Common Services	794	637	0	7	1438
Plant Sciences	1816	399	0	103	2318
Chemistry	2362	373	0	145	2880
Animal Sciences	1703	363	0	128	2194
Environmental Technology	1485	698	0	170	2353
Acid Deposition and Alberta Environment Research Trust	21	85	430	64	600
Total	8181	2555	430	617	11783

Organization Chart